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Physical Design of a Video phone for people with mild dementia

Mattias Gloor

Masterprogram i människa-datorinteraktion
Master Programme in Human-Computer Interaction

UPPSALA
UNIVERSITET

Teknisk- naturvetenskaplig fakultet
UTH-enheten

Besöksadress:
Ångströmlaboratoriet
Lägerhyddsvägen 1
Hus 4, Plan 0

Postadress:
Box 536
751 21 Uppsala

Telefon:
018 – 471 30 03

Telefax:
018 – 471 30 00

Hemsida:
http://www.teknat.uu.se/student

Abstract

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This thesis provides an explanation and description of a new technological product that will directly aid people with Mild Cognitive Impairment (MCI) and Alzheimer Disease (AD): a technologically advanced, yet easy-to-use video phone. If used as intended, this device will make the user's life much easier and more pleasant. A previous study that will be mentioned later in the paper showed that people with dementia often have problems using ordinary telephones. These problems vary from the inability to remember how to use the device (or even recognise it), identify with whom they are speaking, to the user having extreme difficulty in coordinating the use of buttons to the desired function. All these problems can cause stress and confusion to the users. For this reason, I want to create an easily-operated product that will simultaneously improve users' quality of living by enhancing the process by which they frequently interact with others, and by making this same process very simple in order to keep users away from unnecessary frustration.

The purpose of this study is to find an easy way to allow them to interact with their family, friends, and health care givers with a simple click, and create a system that can help users by displaying images on the screen that demonstrate to them how to handle other technological devices. The images on the screen will directly relate to the objects used and will illustrate how and what to do with each one, allowing users to learn from practice and muscle memory. This video phone is composed of a 15 inch touch screen (with an emergency button to press) and a handset to answer the calls. It will be connected to a fast LAN network in order to keep the call costs free and maintain a high-quality screen resolution without buffering. While I shall take care of the actual hardware, my classmate Biwei Wang will focus her job on the interface software that will be implemented in the video phone. Relying on very intuitive commands and instruction, and simple-to-use programming, it is the device that has always been missing for people with light dementia. All the steps of the creation process (through a user-centred design method) will be explained, from the original idea to the physical prototype. Once the device is created, it will be thoroughly tested on the users. The results will be employed for a second iteration which will provide excellent groundwork for future research.

Handledare: Stefan Lundberg and Oskar Jonsson
Ämnesgranskare: Lars Oestreicher
Examinator: Anders Jansson
IT 10 055
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LIST OF ABBREVIATIONS

AAA	American Alzheimer Association
AD	Alzheimer Disease
GUI	Graphical User Interface
HCI	Human Computer Interaction
KI	Karolinska Institute
Low-fi	Low-fidelity
LAN	Local Area Network
MCI	Mild Cognitive Impairment
MMSE	Mini Mental state examination
SUS	System Usability Scale
UCD	User Centred Design

SUMMARY:

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BACKGROUND:

In this section the reasons of this project will be explained, from its purpose through the realisation until the final conception. There will be a description of the video phone and its components. In the second part there will be a section about Alzheimer disease: what it is and which different levels of illness exist. A paragraph will then describe some relevant problems about the interaction of the target group of users and technological devices in general.

INTRODUCTION:

The purpose of this research is to create a video phone easy to use for people with MCI (Mild Cognitive Impairment) and AD (Alzheimer Disease). It will work over the internet with the IPv6 protocol so that all the calls will be free of charge and the quality of the image and sound will be high without buffering or interruptions. The basic idea is similar to the well-known Skype program. However, there are two main differences, with the first being that it will not require as many steps to be successfully used. (The steps include starting the computer, connecting to the internet, opening the program, selecting the user to call, pressing the video-call button, and eventually connecting the webcam and headset with a microphone.) The other important difference is that it will always be connected for incoming calls. We should keep in mind that people in our target group have difficulties in remembering steps that come consecutively (R. Orpwood, A. Sixsmith, J. Torrington, J. Chadd, G. Gibson and G. Chalfont, 2007), especially if they are lengthy, so the easier and more intuitive the product is, the better.

Both the video phone aspect and its interface should be extremely easy to understand and use, preferably relying heavily on instinct. For this reason, it is important to consider some aspects from other devices users work and handle in everyday life, as it will help them remember and recognize the product more easily. Here is a list with some attributes that could help users to remember that it is a video phone and not a TV or another device:

- **A telephone handset** that they will need only to pick up from its location in order to answer incoming or make outgoing calls.
- **A typical and old styled ring tone** to catch the attention of the users. It would be loud enough to be heard even by people with hearing problems in a distant room or a garden.
- **A webcam** which should be positioned behind the screen, if possible, as it allows more eye-contact during communication. This added eye-contact would significantly enhance the communication because, with the current technology, it often seems as though the other speaker is looking somewhere else than at you, which can add to the isolated feel those with Alzheimer's Disease often have. This is a common problem for videophones that has not yet found a frugal and functional solution. This point will probably be difficult to achieve, but let us keep it in consideration for further development for when technology will have overcome the obstacle. However, seeing it on the top of the screen will, more than likely, help them remember that that is where the image will be captured.
- **A clearly-labelled "Help" button** that will start a tutorial video that teaches (or reminds) users how to use the video phone. It would be put in a different place from the navigation buttons. It is very important to divide the more difficult tasks in "small sub-tasks," but not too many in a row, as it may be too difficult to remember.
- An emergency button for immediate calls to the health care centre should also be available and easily accessible. Users should learn that, in case of an emergency, they should not panic and just press this big red button. According to some experts in the field, it should be the only available button on the frame. However, that is only possible if we assume that the interface is accessible through a touch screen.

- **A brand label** that is called "video phone" (or in Swedish "Bildtelefon"). It will be put in relief on the frame.
- **A webcam "Switch-Off" button** to switch off the camera in case, for that moment, the user will not be seen. This could also be achieved by a cover that would physically cover the camera, which may be more intuitive and can provide immediate feedback.

This device has the intention to improve the *quality of life* of its users by allowing them to interact with relatives, friends and the health care staff through a video image. This visual impact will reduce the sense of social isolation these people feel because of their illness. In previews studies it has been demonstrated that, through remote images sent into their home it is possible to improve their happiness. (R. Orpwood, A. Sixsmith, J. Torrington, J. Chadd, G. Gibson and G. Chalfont , 2007)[i]

Another useful task that can be achieved with the video phone is to show, in practice, a user how to accomplish other kinds of tasks simply by showing them what to do on the screen. For example, if I want to show someone with the product how to set the alarm clock (and I have the same device at my place), I can explain and demonstrate to the patient exactly what to do, and, because of the immediate feedback, I could actually check if he is doing the right movements.

There is an ongoing increase in use and development of technology in the world, which influences the everyday lives of most people. Technology has, more and more, become part of everyday life and is a component of the environment, regardless of whether or not people are able or willing to use it. For this reason, there should also be a way for people with dementia to access such technology. If a grandchild is studying abroad, he should be able to communicate with his grandparents through Skype, as he does with his friends, teachers, and parents. It is free for all, yet not available to those with dementia, pragmatically, because they cannot learn the many complexities of modern technologically. Skype is not easy to use; I know from experience. When I tried to explain it to my mother (who is 50 years old and has no memory problems), it was extremely difficult.

Programmers and engineers take for granted that everyone is able to use the technology they create, and, if they are not, users will learn adequately through guidelines and tutorials how to use it. But, in actuality, that is not always the case. As we will later discover, when AD and MCI will be described more extensively, people with these problems have significant difficulties in learning and remembering new actions and tasks

Another reason why I have chosen this topic for the Master Thesis is that in the future I should like to do something for the elderly people. It is known that in the next 10-20 years there will be more and more people in the age range between 65 and 100 years old. So it is really important to keep them in consideration and create something that is usable for them as well. We should consider that even if the new generation of elderly people was probably already working with technological devices their sight, hearing and movements skills will not be the same as the ones of a younger person. As a consequence we should create a series of specific tools and devices that will be expressly conceived for this target group. So that the aging will not be a barrier to technology.

ALZHEIMER DISEASE AND LIGHT DEMENTIA:

A short description of the two considered disease will be made in the following paragraphs in order to explain the different stages of the Alzheimer Disease. This part has been introduced for readers who have little knowledge about the domain.

Dementia and mild cognitive impairment (MCI) are common conditions among older adults, with a prevalence of approximately 5.5 million persons diagnosed with dementia in the European Union in 2003, and 27.7 million worldwide in 2003.(Wimo, Jonsson & Winbland, 2006)[ii] In the United States there are 5.3 million people affected by Alzheimer (2010). And this number is rapidly increasing due to the longer life expectation and the progress in the medical field. Most of this patients are living independently at their own home and members of the family or friends are taking care of them. Others are assisted by some health care personnel that check them regularly. But once those people are not able to live by themselves anymore because the illness is in an advanced stadium then the recovery in specialised structure is required for their safety.

This is a brief summary from the most recent report (2010) from the Alzheimer Association: Dementia is characterized by the loss of or decline in memory and other cognitive abilities. It is caused by various diseases and conditions that result in damaged brain cells. To be classified as dementia, the following criteria must be met:

- It must include decline in memory and decline in at least one of the following cognitive abilities (the decline in cognitive abilities must be severe enough to interfere with daily life):

    1) Ability to generate coherent speech or understand spoken or written language;
    2) Ability to recognize or identify objects, assuming intact sensory function;
    3) Ability to execute motor activities, assuming intact motor abilities, sensory function and comprehension of the required task; and
    4) Ability to think abstractly, make sound judgments and plan and carry out complex tasks.

Different types of dementia have been associated with distinct symptom patterns and distinguishing microscopic brain abnormalities. Increasing evidence from long-term epidemiological observation and autopsy studies suggest that many people have brain abnormalities associated with more than one type of dementia. The symptoms of different types of dementia also overlap and can be further complicated by coexisting medical conditions.

Symptoms of Alzheimer's Disease:

Alzheimer's Disease can affect different people in different ways, but the most common symptom pattern begins with gradually increasing difficulty in remembering new information. This is because a disruption of brain cells usually begins in regions involved in forming new memories. As damage spreads, individuals experience other difficulties as well. .
The following are warning signs of Alzheimer's

- Memory loss that disrupts daily life
- Challenges in planning or solving problems
- Difficulty completing familiar tasks at home, at work or at leisure
- Confusion with time or place
- Trouble understanding visual images and spatial relationships
- New problems with words in speaking or writing
- Misplacing things and losing the ability to retrace steps
- Decreased or poor judgment

- Withdrawal from work or social activities
- Changes in mood and personality

In our study, we consider only the first phases of the illness because after a certain stage, those people are not able to live independently anymore. Dementia and MCI affect the memory and some cognitive functions, making it difficult to handle new technologies, such as a video phone. There currently is a test that helps locate people in their stage of dementia, which is known as the **Mini-Mental State Examination (MMSE) or Folstein Test**. (a copy of the test is in the annexe section A4). It is a 30-point questionnaire test that is used to determine if there is cognitive impairment. It can also be used to estimate the severity of cognitive impairment at a specific point in time. The illness is very regressive, so it is better to repeat the test for more accurate results. Any score greater than or equal to 25 points (out of 30) is effectively normal (intact). Below this, scores can indicate severe (≤9 points), moderate (10-20 points) or mild (21-24 points). Our target group is located in the scale between 21 to 24 points in this test. Other important matters, that came during our conversation with the experts in KI hospital, are that users with this kind of impairment usually are not motivated to learn new things. They usually prefer to write their own guide instead of using the one provided with the product they buy.

DIFFICULTIES TO CONSIDER FOR TECHNOLOGICAL DEVICES:

There are many factors to consider when designing technology for people with disabilities. Most of the products on the market are not made to be used by people with cognitive impairment and, therefore, are not completely accessible and functional for them. Another point to consider is that today, many of the services within western society are provided through the use of computers, telephones, and other electronic systems (Selwyn, 2004; Selwyn, Gorard, Furlong, & Madden, 2003). In addition to this, our homes are becoming increasingly filled with electronic equipment such as remote controls, microwaves ovens and several mobile phones per household. For many houses and apartment complexes, electronic numerical codes are required to access buildings and to administer everyday financial transactions. There is no doubt that this development brings many advantages in terms of safety and efficiency, but potential hazards associated with inappropriate use have also been identified. For example, the perceived ease of use of an artefact and peoples' cognitive ability, in addition to their attitude towards technology, are often said to influence use (Selwyn, 2003, Selwyn and al., 2003). Having the importance of technological impacts on everyday life in mind, it is essential that everybody has the possibility to access such technology and enjoy its advantages.

But what are the most common problems discovered concerning the relationship between patient and device? In a study conducted by C. Malinowsky, L. Nygård, and A. Kottorp, it has been found that people with AD and MCI have difficulties in managing series of letters and numbers while using a set of different technologies (e.g. remembering and dialing the correct telephone number, typing several login codes to computers from memory, understanding text pages on television, etc). Managing a series of letters and numbers could lead to cause unexpected responses from the users.

Also, the coordination between two or more parts of the same technology can lead to confusion. For example, when they have to manage the TV with the remote control and it is required to push a button on a different tool in order to interact with the television. This aspect must be taken in consideration when conceiving new devices for users with Mild Cognitive Impairments. This suggests that this performance skill item may perhaps be divided into two part when tested or evaluated: one assessing more concrete coordination of different parts of a certain technology, and the other assessing more distant coordination. (C. Malinowsky, L. Nygård and A. Kottorp, 2009)iii

The consequences of non-use of technology may not only have a negative financial impact, but also on the emotional side it could have repercussions. Elderly people have difficulties and hesitance in using technology and that leads to a social exclusion. People with dementia are even more endangered by

this problem. For this reason, it is important to know what a user can and cannot do, along with an explanation of the WHY. (C. Malinowsky, L. Nygård and A. Kottorp , 2009)iv.

If a technological device has reported a period of non-use, this can lend to two conclusions: either it is not important for the user any more or it is causing him unexpected difficulties in managing it. This is something to monitor all the time, as it is essential to the effectiveness of the video phone. It needs to be understood why the participants use the video phone continually, or if they do not, why they chose to stop using it.

In another study conducted by L. Nygård and S. Starkhammar it was discovered that there are four main barriers to everyday use of technologically oriented items:

a) interfering conditions related to the person, the context and the design of the artefacts,
b) limitation in the participants' knowledge of the technology and its potential,
c) difficulties in direct technology use, characterized by communication problems both in understanding and in the administration of the technology.
d) the way the participant use the instruction for use.

Between the possible problems it is possible to find: memory deficits; sensitivity to stress; design of the artefacts, uncertainty about the functional aspect of technology; identifying, interpreting and knowing how to respond to information from technology; sequencing actions in line with the demands of the technology; using appropriate force and tempo in line with the demands of the technology; choosing a command or button from a variety of alternatives; coordinating two parts of a technology. (L. Nygård, S. Starkhammar , 2007)v. A majority of the time, the participants of the study were blaming themselves (or their problem with their deficient vision) instead of the design of the technology that was too small or too complex for them. They accept the fact that if something has been created and commercialized, then it should be a good product. This is largely because, so far, there are very few products specifically created for them. However, I hope this trend is going to change and that, someday, also smaller groups will be considered in the future.

METHODOLOGY:

In this section a description of the three main methods that have been used in the creation process of the video phone is provided and the reason why those methods have been selected. The most important one is the User Centred Design where the creation of a new technology turns around the final users that will need it. Then inclusive design technique is introduced due to the particularity of the target group. And finally some theory about the Usability testing that will be implemented at the end in order to evaluate the work done.

USER CENTRED DESIGN

The method used in this project is a **user centred design (UCD)** because it is useless to create a product or a service that the final user does not like, need, or will never use (due to being too difficult or useless for him).

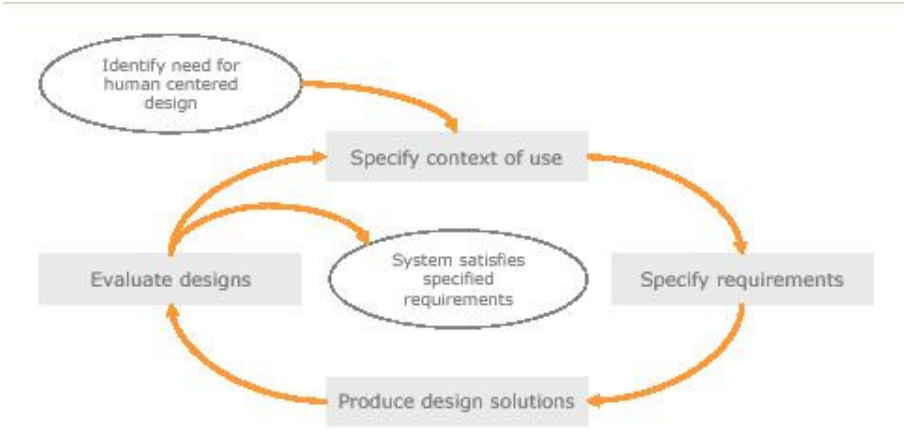


Fig. 1: User Centred Design process from User Centered Systems Design class thought by Jan Gulliksen

The first step (see Fig.1) is to identify what the people need or want. It is all about the vision and plan of the device that has to be created. Usually this first step is performed by analyzing the users on the field, watching them interacting with the old technology that will be replaced by the new and better one. It is also possible to interact with the users and ask them why they do certain actions, what is on their minds, how they perceive the existing tools, and what their desires for the next generation are.
In our case, it will not be so easy to interact with the final users and ask them their preferences in face-to-face interviews. There are several problems, the language barrier being a very large one; I speak English and they probably communicate solely in Swedish. Their attention span is very short when you ask them difficult questions or make them think for too long, which can exhaust them and may cause them to refuse cooperation. It is not easy to go where they live because they generally do not like having unknown visitors at their place. Last but not least, there are ethical matters that impeach us from meeting them personally. A formal request must be forwarded and accepted by a committee that has council once a month.
My solution to this obstacle was to collect the information through a background survey, a 13 question formulary. It would have to be read aloud, completed, and signed by a health care giver. Eventually, I shall analyze it to find out detailed background information. Afterwards, it would be productive and helpful to speak with the care givers and professionals that have some expertise about the disease and the needs their patients. They will help to fill in the blanks and provide an overall better, more complete overview.

After that, it is possible to use two other methods that are very useful to understand the user's needs. They are called scenario and personas. In both of them, you can imagine possible scenarios and ways of employing the device in original contexts and by different kind of users.

Once all of this valuable information is collected, I shall conceive an introductory, yet concrete, idea. From the different details in our possession, I shall be able to draw a first low-fidelity prototype that will be the starting point of my work. I will receive extensive feedback from the experts in this field. After the feedback has been received and analyzed, a list of specifications that have to be integrated in the device will be written down. It will be a type of check list, so that the engineers that will build it will not forget any important characteristics or components. It will then be time to prepare a prototype that can be tested. It will not be a working, physical one at this point, but a 3D model that the participants will be able to touch and interact with it, in order to evaluate the use of the item in context.

After a 4 tasks usability test with the prototype we will ask the users about their first impression, a complete feedback about their expectations, eventual evaluation and perceive where eventual troubles are. With this new data, we will be able to correct mistakes and small problems in the prototype and adjust it according to helpful, constructive thoughts and wishes. We will come up with a second prototype, retest it completely, and discern whether the product is efficient and useful in the current form. After this, we will produce a fully functional video phone to eventually present it at the next meeting of the Alzheimer Association in the United States, next fall. Once the device is completed, it needs to be re-evaluated a second time from another test group, preferably from people with a different cultural background (meaning non-Swedish/Northern-European citizens).
When the product is in construction, and eventually deployed, we must always remain focused on the objectives of the video phone. That means to continue to focus on the users and the usability of the device, to be ready to adjust where and when difficulties arise, or improve where faults are discovered. Keeping the product up-to-date with the last desires and needs of the people that will be using the device is the prime focus. The next two topics are other methods (Inclusive Design and Usability Testing) that will be taken into consideration during the design of the prototype for the video phone:

INCLUSIVE DESIGN:

From British Standard 7000-6:2005. Guide defines **inclusive design** as

"The design of *mainstream* products and/or services that are accessible to, and *usable* by, *as many people* as reasonably possible ... without the need for special adaptation or specialised design."[vi]

Inclusive design is about ensuring that environments, products, services, and interfaces work for people of all ages and abilities. It can also be called design for all and has the task of integrating disabled people into mainstream society. The principle is that we should not create an interface or product for every different group of people, but a common tool or design that is going to work for everyone as easily as possible. In this project, even if just in principle, the phone has been created for a specified group of users. However, that does not imply that they will be the only ones allowed or able to use it. Finally, it is an easy-to-use phone suitable for most of the users. It could be used as a quick contact method in small or medium-sized companies, as emergency line in hospitals, or even by families that are separated world-wide and want to stay in contact for free and are not able or willing to use a computer. The important aspect here is that most of the population will benefit from this product and will easily be able to make video calls with just one or two clicks on the product and with no charges added per minute.

USABILITY TESTING:

With this third method, we are going to evaluate the prototype before starting the production and commercialisation. It is a very important step to accomplish in the development of a new technology. By investing sufficient money at this early stage, the producing company will, in turn, save a considerable amount (proportionally) in later stages by pre-emptively handling updates, user complaints, or further information requests at the Call Centre. First of all, what do we mean by "usable"? When a product is truly usable, the user can do what he or she wants to do the way he or she expected to be able to do it, without hindrance, hesitation, or question (J. Rubin, D. Chisnell). But let us investigate a bit further into the term "usability" before describing what Usability Testing actually is. From an academically congruous source, according to the ISO definition (ISO 9241) "usability" is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." A small description of the three key words in this definition are the following:

Effectiveness: The accuracy and completeness with which users achieve specified goals.

Efficiency: The resources expended in a relation to the accuracy and completeness with which users achieve goals (which is usually calculated in time).

Satisfaction: Freedom from discomfort, and positive attitudes towards the use of the product.

Usability testing refers to a process that employs people as testing participants who are representative of the target audience to evaluate the degree to which a product meets specific usability criteria. Before all, a test plan will be created, then we will proceed with the testing part, and, finally, we will come up with a report document with the findings about the prototype. However, the complexities of "usability" will be thoroughly expounded upon later.

Testing tactics

- Define the goals and objectives of the test
- Specify a suitable setting and framework for testing
- Determine observational criteria and factors to be measured
- Specify or clarify the nature of the targeted user population
- Devise test cases or task scenarios suited to the target users and the testing objectives
- Recruit representative test subjects
- Conduct test with observation and measurement.
- Summarize and analyze results
- Formulate conclusions and recommendations
- Compile and communicate findings

RESULTS:

In this section of the paper all the results achieved will be summarized and then elucidated. Different kind of information have been gathered from the initial phases until the final test with the prototype and all of them provided useful results that have been described in the next pages.

INVESTIGATION:

The first step was to speak with a research group of Karolinska Institutet in Stockholm (Flemingsberg) that had already conducted several studies on people with light dementia or Alzheimer and their relationship with technology. (Some of them are reported as references in the works cited.) The people I interviewed were Inga-Lill Boman and Lena Rosenberg, both of them are experts in the field and have a good knowledge of the domain studied in this research. From this meeting, which took place on 25th February, 2010, I gathered a solid basis of knowledge in this domain and received suggestions concerning how this project has to be developed. The important information gathered during the meeting was:

They have direct contact with people with dementia and Mild Cognitive Impairment, and they are willing to help us to collect information and to share their previous knowledge in this domain with us. Their help has been precious and indispensable. It will not be possible for me to have any direct contact with the participants, due to ethical reasons that must be approved by an Ethics Committee. (This procedure takes too long to fit into such a short time schedule and, most likely, will not take place for this project.)
The patients are usually not motivated, or are not able, to learn a new technology, so the device has to be as simple and intuitive as possible. It is not recommended to give them a guide book or user manual for the device, as, most of the time, they will not use it or will have difficulties in understanding it. Frequently, they create their own version of a guide and use it only when they feel it is necessary. After considering how to write a manual for our product, an important question arose: will they actually use the video phone if they already have a normal phone? One of our tasks will be to demonstrate to them the advantages of using this device and try to convince them to use it. Otherwise, the people that call them via normal telephone should ask them to switch to the video phone in order to be able to see their appearance and discern if everything is in order at home. It is also very important to have some sort of feedback noise that will reassure them that the product is in working order. For example, when they pick up the handle, there should be the characteristic sound of a free line or dial tone. That will help them understand that it is a phone and it is working. The same principle applies for the buttons. When they press the buttons, there should be a sound or a visual output that shows them it has been correctly selected.
As has been explained already, the investigation will be conducted at first time with the help of a survey and several face-to-face interviews with the health care givers and other experts in the field. The questionnaire has twelve questions and all have multiple choice answers. In addition, the interviewer took some notes on the side about what the participants were commenting on during their answers. That gave me more than sufficient material to work on and many excellent suggestions as well.

You will find a copy of the survey in English (A1) and Swedish (A2) that has been distributed to the participants. The results (A1) I have gathered from this survey about their preferences are located in the appendix.

THE DEVICE:

In this section, I will describe more specifically the different components of the video phone I should like to develop. There will be different parts designed for the item since it is an iterative and creative process. I have brainstormed several different ideas and made subsequent adjustments while I was working on it and imagine that such pattern will continue all throughout the following campaign. I must clarify that the project leader for this video phone previously established some prerequisites about the basic characteristics. There will be a section with their idea, one with my original idea, another with the adjustments made after having gathered information from the survey I gave to the participants, and a final segment with a new and different concept I personally conceived. I will thoroughly plan the hardware, the actual shape, size, gadgets, and the buttons (specifically how many there should be and where) for the navigation. On the converse side, my classmate Biwei Wang will take care of the user interface and the setting options. We will have an abundance of feedback communication and discussion in order to be coherent and efficient between the two distinct, yet related, parts of the final device. In this part, there will also be an explanation of the motivations that influenced the choices that have been made. Such decisions are founded on the knowledge acquired during my two year Master education in Human and Computer Interaction (HCI), from the references to previous studies, and the survey.

The AAA (American Alzheimer Association) idea written by Louise Nygård:

The document is protected by a non-divulgation and duplication request, but the essential description proscribes that the device will be constructed around a mid-sized computer with a 12-15'' screen. On the computer, a web cam will be situated above the screen and it will not be moveable. There should be a handset to answer the calls, and the computer will be connected to internet..

My First idea :

- The Screen: it should be approximately 15 inches large. A touch screen may prove to be the best form, as the user will have the buttons in very visible areas to press. If that is the case, then a sensitive, but not too delicate, screen must be adopted. (There is the risk that they will damage it if they press to hard on sensitive screens.).
- Ring Tone: old styled and familiar (e.g. "Riiiing Riiiing")
- Phone Handset: with a cord or cordless?
- Emergency Button: a red button so that if there is the need for help, the user can just press it and it automatically call the hospital or health care staff.
- Good sound quality: no echo or buffering, no distracting background noise, possibility to adjust the frequency (Hz) by the experts (hidden regulation button for bass, middle and high sound).
- Webcam: high resolution, no buffering, fluid transmission, if possible placed behind the screen, possibility to have a separate Bluetooth camera to take with you and show around.
- It should be aesthetically pleasing and designed to be kept in the house. However, it is essential that people remember that it is a video phone and not a television, so there needs to be a clear distinction in style and form.
- Easy to use, very intuitive. Use few/one step(s) in order to work.
- When grabbing the handle a dial tone should come out to help them recognize that it is a fully-functional phone.

- There should be a component that emits a sound if the handle is not hung up correctly (to double check: position of the handle + signal absence). An easily recognizable, particular sound or a voice should remind them to hang up.
- If the user is already speaking with someone and he receives a second call, some kind of alert should appear on the screen.
- Should the user see himself somewhere or not? (small window like Skype).
- Provide a paper-based guide to help the user commence (similar to an airplane's emergency instructions with sketches).
- Hidden setting panel and menu (USB, keyboard and mouse entry and setting buttons).
- Volume adjustable with buttons (but not reachable by the user)

The participants idea:

After having read the results of the survey, I have collected a new set of information that will be very useful in the development of the final prototype. Firstly, they were initially very interested in the device because they like the idea of being able to see someone while speaking through the video-phone. Also, I learned that they would like to have the possibility to choose whether or not the webcam is on or off depending on who is calling them and if they are in the condition to be seen (e.g. if they just got out of the bed). The results also show that they want to be able to choose the ringtone of their preference in order to distinguish it from the sound of other devices in the house that could lead to confusion. The video phone should be easy to use in primis, but also movable according their desires, regardless of whether or not a patient said that it would be easier to find if it is always at the same place. It should not be too big, but should include large and easily recognisable buttons. They like the idea of a hands-free device, but sometimes the necessity of a handle to answer is important if there are guests at the home and they want to preserve their conversational privacy. They expect to add 4 to 15 contactable people on the phone; for this reason, maybe it is better to opt for a touch screen interface instead of adding too many buttons on the device, that could lead to confusion. They would like to move the camera around if possible, but, according to the experts in the field, that is not a good idea because they could lose the camera in the house. According to the survey, most of them preferred a compact design, but if there would be a touch screen then the size of the display has to be big enough to be easily used and understood.

A new idea - a portable video phone:

During my Thesis presentation the opponents and the thesis supervisor were really interested in my idea of a portable video-phone with a hand mirror shape. I have just mentioned in my report because even if I thought it was a good idea and I really liked the concept the experts in KI did not like it and told me to go ahead with a more basic solution.

Thanks to the enthusiasm of the people attending the presentation I decided to develop a bit further this concept. It is basically a transportable videophone, but attention, it is not made to be taken outside the house.

The patients will be able to pick up and carry around the flat the device so that firstly they can freely move while calling someone and reach another piece if there is the necessity, or even carry or keep the device next to the bed if they feel tired or ill. It should be light to carry and comfortable to hold.

The expert told me two "problems" that could not work with this device and people with AD and MCI, the first being that they would forget where they drop it and would not be able to find it anymore and the second was that they would not remember to charge the device up. But for both problems there is a really simple solution. The first was already predicted by me in the 3D models you can see there is a red button with the label "Find" on the base station that allows the user to find the device by pressing

it (it will start emitting a sound and the patient should just follow the sound until he finds the tool). For the second issue, I can imagine a sound feedback when the phone is reaching the 20% of its autonomy. Let say a combination between an alarm sound and an image displayed on the screen telling that the battery is almost empty to take the device back to the main station and showing them how to place it in the right hole to start charging it up.

Having a smaller display will affect its navigation, instead of using a touch screen interaction, four colored buttons will be placed on the two side of the device(two per part), everything will be color related during the navigation. If there is a possible action to accomplish then it would be in one of the four color corresponding to the buttons. Even if a patient is color blind he would still be able to relate the color on the display to one of the four buttons being of the same color for him. There is a fifth button on the top of the device that allows the users to switch it off or decline an incoming call.

On the charging station there will also be a indicator of the battery status, if it is charging (orange blinking light) or if it is charged (green light).

It was a pity that the people did not consider this alternative, because in my opinion there is a huge potential once developed and designed an appropriate interface. I understand that they had something different in mind when they asked me to come up with a prototype, but it has really been discharged to fast and with some reasons that could be easily fixed.

Feedback received on the Portable Video-Phone from the experts:

According to their advice, a portable video-phone will not work for those with dementia because they will not remember where they have left the device and will have problems to remember to charge the battery. They will also have difficulties to learn what the find-feedback-sound should remind them to do.

CREATION PROCESS:

Creative design: The first step is to imagine something new and modern by thinking "outside the box". I did brainstorming with paper and pencil over a couple of weeks and came up with several sketches illustrating how I imagine the video-phone to look. All these ideas have then been put in 3D digital models thanks to the software Google SketchUp[1].

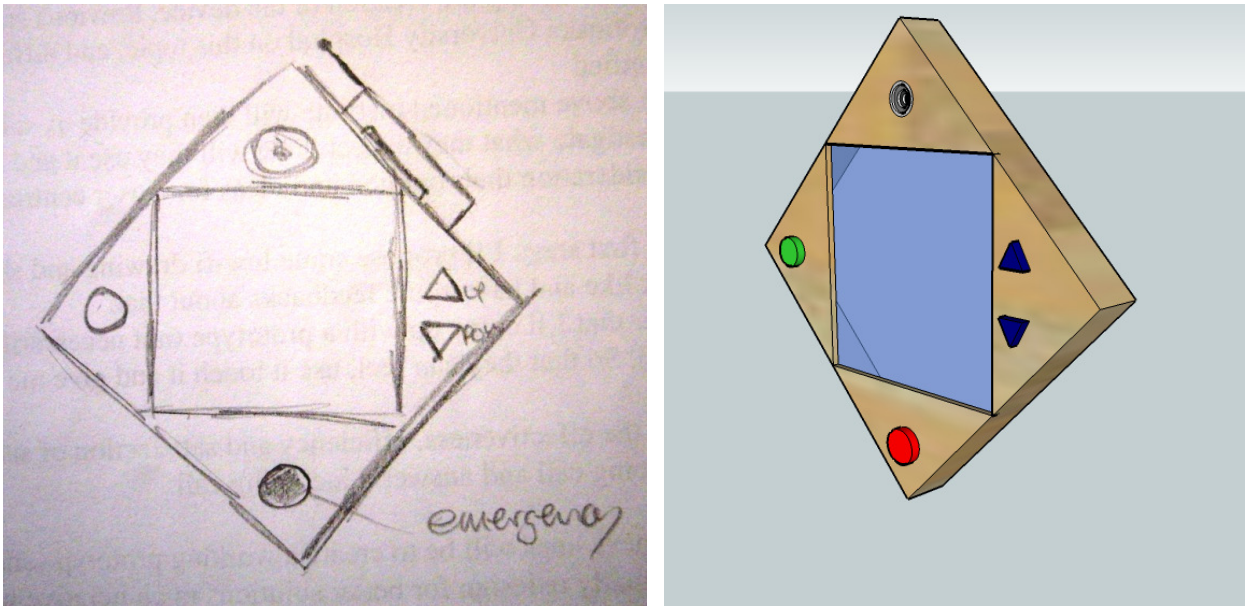
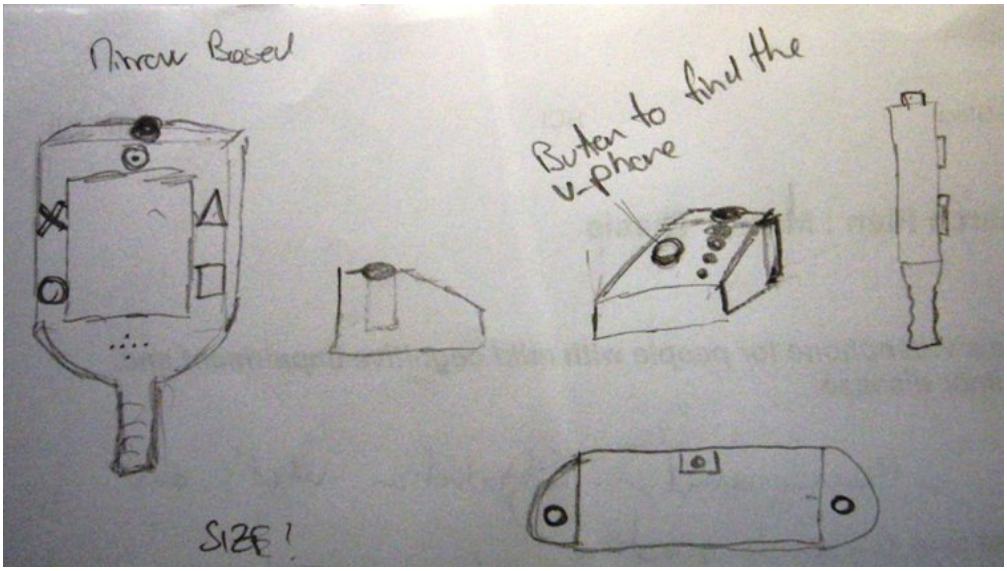


Fig. 2: A more creative design! It is nice to have it in the house, as it can also be used as a mirror.



[1] http://sketchup.google.com

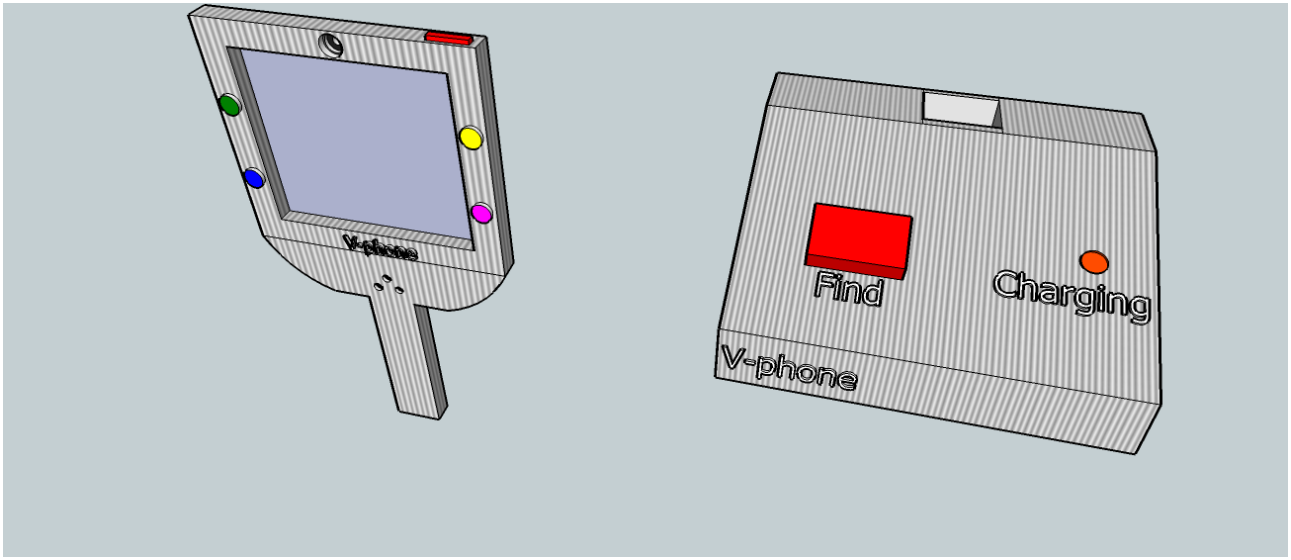


Fig. 3: The portable video phone with a recharging base

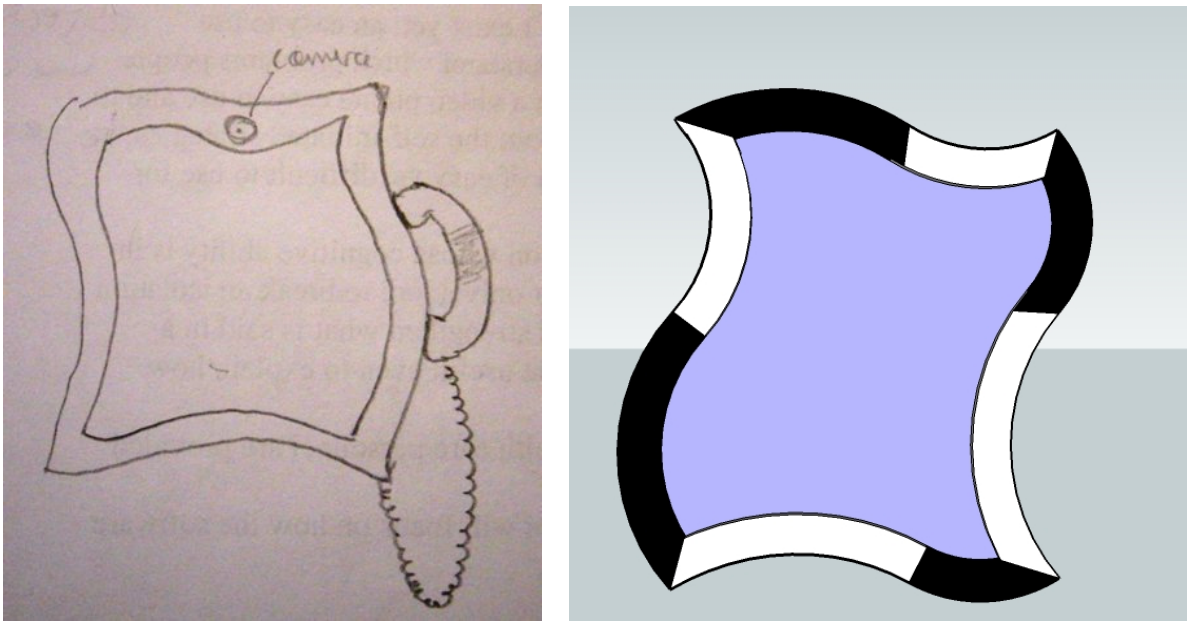


Fig. 4: The Abstract Model

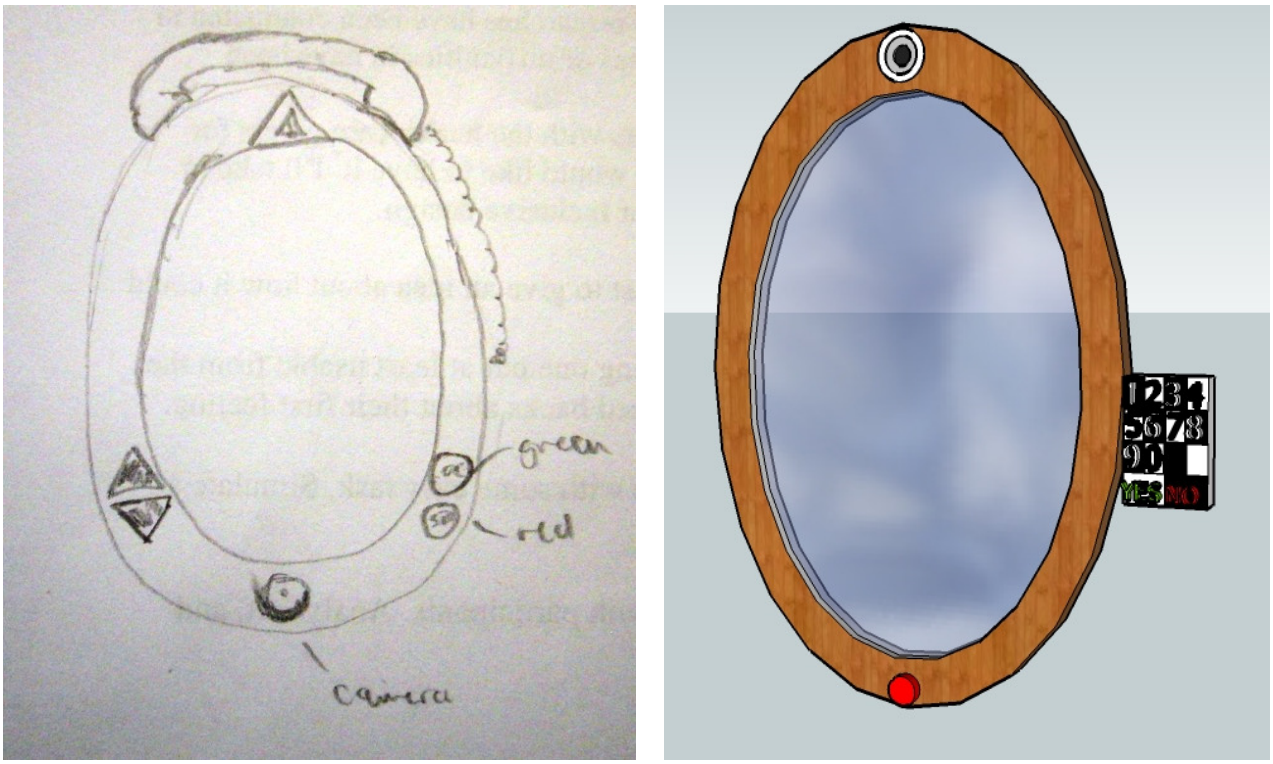


Fig. 5: Wall Mirror-Shaped Screen.

The experts thought those models were too complex and difficult to recognize and decided that any navigation button should be on the physical hardware. Basically, other than the emergency button, everything else would be controlled through the touch screen and its interface.

So finally, the experts in the field chose a much simpler and classic design for the video phone (see Fig. 6) They preferred an iMac-type design, so I tried to get inspired by it.

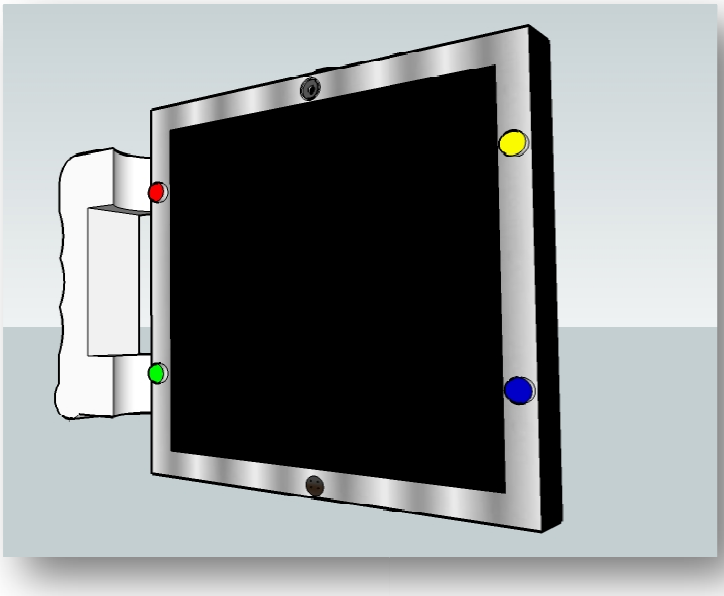


Fig. 6: The chosen idea to develop

Fig. 7: The final prototype with Biwei's interface.

As you can see in this final version the only button available is the emergency one on the top of the screen. There is also a switch on and off button so that the user can chose if s/he will not be reached or disturbed put it in a sleep mode. Under the handset there is a small door where it is possible to adjust the sound output.

PROTOTYPE CREATION:

In the following section, I will describe the path I followed to concretize the idea into the physical prototype. There have been several steps and in everyone of them improvements and modification have conducted to the final video phone concept.

Step 1: My Idea – Prerequisites.

During the first phase, I brainstormed and came up with several different visual designs, which were given form with the help of some simple sketches. After that, I had to learn how to use the new 3D software: Google SketchUp. I achieved this by watching tutorial videos and by reading the program's documentation on the internet. I tried other 3D software, but they were all very complicated (and over-priced). Once I learned how to express myself properly with it, I tried to convert my ideas into 3D models. Many different trials and failures passed until I felt the design levelled to my expectations. Luckily, the more I was using the program, the easier and more detailed the models were becoming. Every single drawing gave me more knowledge and insight for the next one.

Step 2: What the patients want.

The investigation, through the survey, gave me a more detailed, clear-cut idea about what users really want or expect from the video-phone. Fortunately, this caused me to focus a bit more on certain details that I had ignored in the first place, such as the physical cover for the webcam and the fact that it should not stay fixed to a wall but lay on a table and have the ability to rotate in ball-and-socket form.

Step 3: The first solid prototype.

Stefan, the contact person in KTH asked me to provide for them a solid prototype to properly test, touch, and show to the future users and the experts in the domain, so I documented it myself first and discovered that there are 3D printers for designed plastic devices. (Some are strict professionals and other accessible to everyone.) It is possible to print the model of such 3D printer with an already existing and exactly identical model, and spread them out. It is not yet so popular, but I am sure it is something that is going to grow. I was hoping to find someone who had such a device and would help me in printing the prototype in solid plastic, but, unfortunately, that search is still continuing. The professional printers are, obviously, much more expensive. There is a company in Stockholm that works with creative design and the creations of solid prototypes. I had been planning for a period to ask them if it would be possible to borrow their printer for my project, and once I did, they were willing to comply and print the prototype. They will send their price estimation as soon as I send them the 3D model. As an alternative, there is the possibility that I produce a low-fidelity prototype made out of Polystyrene. A new, promising idea for a solid starting prototype is to take a pre-existing touch screen and just put our planned frame around it in order to make physically emulate the video phone, so that we can test it more effectively. For example use a device similar to the new I-Pad from Macintosh.

Fig. 8: The physical prototype frame.

Fig. 9: The physic prototype during the test session.

Step 4: Final version of the prototype.

This version should be the final one, with all the features and buttons in their final position, but it is still not totally functional. It will be the model that the engineers will use to start producing the final product.

Step 5: The final product – Video phone

Once this stage of the process has been reached, the product will be ready to be commercialized. The target group is all the people with early dementia but even elderly people that wish to have a easily understandable video-phone to stay in visual contact with relatives and friends.

THE FINAL PRODUCT:

After three months of iteration and modification, I have come up with the final prototype that will be tested, and the ensuing results will give me the final information before the end of this development and creation project.

Description:

The video phone will have a support holder to keep it standing without falter, but will also be very mobile, as it will allow them to move the item around the house when needed. The first idea to have it fixed on the wall has been substituted by a more practical and flexible one. The size will be medium (or greater) because users generally do not want it to be too small because it is difficult to read the text and find the sought contacts on a small screen. Also, the buttons on the screen could be too narrow if the screen is not large enough. Other experts have added that it should not be too big either, because it would occupy too much space in the house and could be difficult to move.
There are just two reachable buttons for the users, which should help them remember their uses with greater ease. There is one large red button on the top that will be the "Emergency" button, which should be used when the user needs immediate assistance from the health care centre. Phone operators that answer "Emergency" calls will have to be trained to discern if an ambulance, a personal health care agent, or just simple advice given via the video-phone is needed. On the interface, there will be a "Confirmation Request," to decipher if the user is sure that he/she wants to call the care centre. Some extremely important feedback was received via the survey, which showed that users said that the "Emergency" button was not easy enough to reach on the top of the screen. Because their safety and health is the prime concern, it may need to be put on the front, bottom, or even under the screen.
The second button will be used to switch the device off. This may be used, for example, during the night or when they have guests and do not want to be disturbed. For safety, however, there will always be the possibility for the health care centre to switch it on automatically when they are calling. It is just for security reasons, as privacy needs to be respected, but safety checks are absolutely necessary.
The camera will be positioned on the top centre. After considering their specific request to be able to choose who can and cannot see them, a small cover has been placed next to the camera that will permit the user to physically hide the webcam, and, consequently, will allow the choice of being seen or not by the caller. This simple method will be very easy to identify and understand, and will give immediate feedback to the user about the status of the webcam (open/closed). A user who tested the product pushed the camera as a button, but I am sure that if given an adequate explanation, the users could easily learn how to use the camera properly. Hopefully, after being taught how to physically use it enough times, it would delve into muscle memory and become a intuitive process.
There will be a specific place where one can place the handset on the right side of the screen. There will be a sensor that will identify if the user has correctly placed the handset. If the user has not, an animation (accompanied by a voice) will remind to place it properly. This hook should not be too high on the side of the product because the people (many of them being elderly) will have problems in

reaching it. One surveyed user even wished to have it in the front of the screen, like the old public phones, so that it is easier to reach and hang up once the conversation is over.
The handset will be traditionally styled, and must not be too heavy for users to hold comfortably during conversations. There will also be, under the handset hook, a small command door where it is possible to adjust the volume of the output and the sound frequency. That can be done during the installation if the users have hearing problems.
On the back of the device, there is an electricity entry, the internet LAN entry, and one USB slot, which will be used in order to configure the software: add names, number, photos, etc. It could eventually also be done through internet on a local server where it will be possible to edit this kind of information. There will be a name on the device that will help distinguish it from the television or a computer screen.

TEST AND EVALUATION:

It is really important with this kind of users to test a device only once it is working and practically functional. They will not understand if we try to show them some drawing for the interface and ask which button would you press now, if there are not real buttons to press. They would get anxious and distressed (R. Orpwood, A. Sixsmith, J. Torrington, J. Chadd, G. Gibson and G. Chalfont, 2007)[vii]. So we will test the final users only when the design has become reasonably reliable and the prototype has a distinctive and real shape with interacting buttons and a handset.

The Test Plan is in the annexe (A3) with a detailed description of the tasks and the procedure we are following. The results will be summarized in the following paragraph and will focus on the three usability factors.

The efficiency is the approximate time needed to achieve every single task. In this part, I will calculate the necessary time to solve the task, successfully or not. The gap will later be statistically elaborated in order to understand which tasks are less effective and for what reason.

The effectiveness consists of achieving the goal. I will measure the success ration by accomplishing every different task. There will be a variety of middle points that will be taken into consideration. For example, if when trying to call the emergency number, they take the handle but forget to push the button to dial the correct number, I will consider it to be only half victorious. That means they understand at least that you need to take the handle in your hand in order to start, even if, on the results, it will be a missed task..

The satisfaction cannot be gathered by observation; although, it is possible to note the frustration or reaction of the users while they are testing the device. The satisfaction will be measured at the end of the experiment by asking them easy questions in the same format of the survey. I could use a predefined one, like SUS or similar or create an easier one for this particular target group.

With such information, it will be possible to conduct a more thorough analysis of the device and its usability. Once the results have been interpreted adequately, it will be much easier to proceed with the next steps of improvement to the device in the next iteration cycle.

THE PARTICIPANTS:

Unfortunately we could not conduct the test as we wished in the beginning at KTH, because of some organizational problems. So we had to improvise and, thanks to our teacher Lars Oestreicher, we found three participants willing to test our prototype in an elderly house in Bålsta. The test was conducted in their apartment to make them feel more comfortable.

The background of each participant from pre-test questionnaire is reflected on table 1.

	Participant 1	*Participant 2*	*Participant 3*
Age	64	93	97
Gender	Male	Female	Female
Experience in using a computer	Seldom for work	Never Used	Never Used
Used touch screen before?	No	No	No
Prefer touch screen or physical button	Touch screen	Buttons	No Answer
Used program of videophone on a computer? (Skype, etc.)	Yes	No	No
Used videophone?	No	No	No

Table 1: Pre-test result

RESULTS:

All the results of the test session can be found in tables in annexe 6 (A6) at the end of the document. But it is important to go through some interesting findings.

None of the participants had real computer experience or had ever used a touch screen before, despite of that they understand the way the device worked and performed the task they were asked to do. We had just some task failure with the last participant. The other two participants did everything perfectly.

As it results from Table 2, the efficiency was really good, with the first and last task completed successfully by all three users and task 2 and 3 have been achieved by 2/3 of the users. It is in fact a positive feedback for us. If we check at the effectiveness then there are also good results. It is necessary to take in consideration that those people are old and need some time to elaborate the task, and then more time to perform it. For such reason I can affirm that the device and its interface are quite effective for the task the users had to perform. Let us now focus on the satisfaction of the users

	Participant 1	Participant 2	Participant 3	Total
Task 1 Time:	Yes 12 sec	Yes 10 sec	Yes 12 sec	100%
Task 2 Time:	Yes 27 sec	Yes 45 sec	No N/A	67%
Task 3 Time:	Yes 26 sec	YEs 53 sec	No N/A	67%
Task 4 Time:	Yes 10 sec	Yes 12 sec	Yes 12 sec	100%

Table 2: Task results

DISCUSSION OF THE TEST SESSION

Even if the usability test was not performed as we previously expected, it gave us great feedback. The first two participants were really effective in using this new technology for the first time and managed to achieve all the tasks in a short laps of time, considering their age and their aging difficulties (such as deteriorated eye-sight and inability to adjust to quick, speedy movements). The video phone is easy to understand and use. The only problems arose concerning the location of the emergency button and the handset. It was difficult for them to reach it. The participants were all sitting on a chair at their dining table. It is possible to imagine placing the button in the front of the screen, instead of on top of it. Also, to lower the handset or put it in the front, like the public phones. Both of these answers would adequately solve the problems the testers had.

One of the participants was asking why we did not use the television screen for the video phone, it is much bigger and everyone has one, and use the remote control to interact with it. Another one was complaining with the gray borders saying that it was too sad and boring. Otherwise they liked the prototype and they were successful in using it.

ITERATIONS:

In this section, there is a description of the several phases of the creation of the video phone. The prototype has been updated and considerably improved throughout all of the steps of design and production. From the first drawing until the physical prototype, there have been several different steps that needed some more consideration from my part. .
The iterations in a creative design process with user centred design are very important. They allow other people to know how far the work has progressed and what can be changed and improved for the next iteration. It is difficult to make the description create the same image in everybody's mind, and this reason deemed it necessary to have a visual reference for discussion. Thanks to their feedback, it is possible to improve the prototype until a final version that can be commercialized is completed. I will now investigate and test the version from the last iteration and come up with the final preparatory suggestions before the next generation.

IMPLEMENTATION:

Once this creative phase is over, it is then time to put the final design in practice and start producing the video phone. It will be crucial that all the central aspects not be neglected nor ignored. There are specifications that have been appositely written to be considered by the engineers for the technical implementation. The design of the product should not be exactly a copy of my idea insofar as those crucial points are respected.

LIMITATIONS:

Unfortunately, it is not possible for us to directly test people with MCI and AD, so, as a replacement for them, we found a group of elderly people that volunteered to test the prototype for us. We attempted to test people with different backgrounds (sex, age, instruction, computer knowledge, etc).

The creation of a working prototype is not completely possible, as we are not engineers and cannot build a working device. But we will deliver all the specifications and important points to consider, so that their work will be facilitated by our suggestions and no important points will be omitted in the construction of the device. If it proved to be too expensive to print a good plastic replica of the device, I thought recreating (in real scale) a lower fidelity polystyrene prototype would be the next best step. It will, of course, be explained to the participant of the test that they should not consider it as the final product, but as an idea about its shape and the disposition of the buttons and handset on it. I should like to see participants interact with the tool and observe if they understand it the same way as I do. My classmate Biwei is creating the interface that will be combined with my hardware. During the test phase, the GUI will be represented by a PowerPoint animation that she will control remotely with a mouse, but it is not completely working yet.

DISCUSSION:

Several prototypes and ideas arose during the project's lifespan, from the first sketch to the final video phone. The evolution and improvements have been constant and successful, with new information gathered and large amounts of feedback received from both experts and users.

The improvements and adjustments have been unexpected and ventured away from my original plans. If you would have asked me at the beginning of the project if the device would look like this with these characteristics, I would not have even imagined it, as it was so far from the primary concept. It is really thanks to the users, who graciously gave me suggestions about how to improve the original concept, that I had that allowed me to develop the item to this latest, improved version.

Now we have a concept that just needs to be transformed into a working prototype and be tested by a large group of willing users. After those results are in, the video-phone project will be on its way to helping those with MCI and AD. Though, one question did arise: will these people, in fact, use this device or will they continue to use the normal phone like before? How can we motivate them to actually use it? And is their quality of life empirically improved with the help of the video phone?

My hope is, that after all the work that has been done, they will use and enjoy using this new technology. I think that it is important for this kind of patients to have the chance to see someone, even if it is just through a screen, from time to time. And on the other side, it is even more important that the health care staff can check how a patient looks like without having to visit him/her every day. Even the relatives that live far away have the possibility to see for themselves how they feel (and show them how fast their grandchildren are growing).

There are others video products that are studied at the present, some of them are connected to the television, others have wheels and can be moved around the house by a third person (Giraffe), but something like this product has not yet been commercialized. And in my opinion it is a device that could be really helpful for many categories of people, even if has been especially designed and conceived just for people with mild cognitive impairments. Because it is really easy to use and intuitive it could be bought by all those different users that have not great familiarity with the latest technology devices.
Nevertheless we should not forget that practically every new cell phone and new laptop has the video call option with a integrated small camera in the front so that you can call and see at the same time your contact. So there is a huge potential of using this technology in the present and future.

CONCLUSION:

This project has been unbelievably interesting (and indescribably rewarding) to develop from scratch until the final prototype. I think that such a device will be really useful for this specific group of users, and could even be used by other people that just want an easy-to-use video phone. If there will be the chance to connect it with other software, like Skype or with the actual mobile phones that already have the video call option, its utilisation could reach exciting and unknown levels.

From the results of the test, I can say that the product has been easily understood and its functions quickly apprehended. Unfortunately, we had no possibilities to test on people with dementia, but apparently the project leader and his group of researchers are going to test it with the final users this summer. I really hope the results will be as statistically helpful and satisfactory as they were for us in our test sessions.

The only regret is that, for lack of time, it was not possible to go forward to the next step of this product: the working prototype in action. I can only hope this video-phone will become an everyday tool in the life of people with dementia and make their quality of life better.

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General references:

My studies at Uppsala University from the teachers: Mats Lind, Else Nygren, Anders Jansson, Iordanis Kavathatzopoulos, Eric Borälv, Jan Gulliksen, and all the guest lecturers.

ANNEXES:

All the documents used in this master thesis project can be found in this section. Some of them are in Swedish others in both languages.

(A1) FIRST SURVEY RESULTS:

PARTICIPANTS DESCRIPTION

8 Participants took part at the survey, 3 were men and 5 women, their age was between 67 years old and 86 years old ($\bar{x}$ = 78,5 years old).
Half of the population had Alzheimer Disease and the other half had other forms of Dementia. Three participants have been found on a specialized clinic (where all of the patients should have been recruited but due to the lack of time others sources have been utilized), two other participants have been in relation with the interviewer though some memory investigations, one has been suggested from a colleague and a last one, even if he was in a more advanced stadium of MCI has still been included in the survey.
Seven of the involved people were included in a ETUQ-08 investigation, the interviewer choose the one he knew where available and willing to be interviewed. He tried anyway to keep a varied mix between sex, age and people that live alone or with someone else.

Two more participants were supposed to take part the interview, but the first did not manage to send back the survey in time, the second had technical problems during the telephone interview.

THE RESULTS:

Question 1: **Do you know what a video phone is?**

2 participants knew what it was, one had no idea about it. The other five had an approximate idea about the meaning of this word and the device it represent.

Question 2: **How many minutes you spend at the phone every day/week?**

3 participants spend less than 20 minutes a day on the phone, 2 of them spend around one hour per day on the phone. 2 participants spend less than 20 minutes per week on the phone (once a month) and the last one spend around 1 hour per week speaking through the phone.

Question 3: **Are you calling out or receiving the call from someone other?**

half of the participants said that they both make and receive calls from someone, the other half receive calls but usually do not make any.

Question 4: **When you are speaking with your Relatives, Friends, Health Care would you like to see them as well or is it enough to hear their voice?**

Relatives: 4 out of 8 want to see them as well, 3 out of 8 do not want to see them, the last says it depends

Friends: 3 out of 8 want to see them as well, 4 out of 8 do not want to see them, the last says it depends

Health Care: 3 out of 8 want to see them as well, 4 out of 8 do not want to see them, the last says it depends

Notes: 3 out of 8 do not want to see anyone on the screen.

Question 5: **Would you like them to see you?**

3 of them are comfortable with that, 2 are against it and the other 3 say that it depends.

Notes:
It's OK if it is the daughter or some friends (Positive answer)
Not so nice if you just come out from bed and it is someone you don't know (Maybe answer)
Friends and known people are ok (Maybe answer)
The medical personnel should not be able to see her. (Maybe answer)

Question 6: **Which of this aspect are important for you when a new technology is installed in your house?**

Easy to use: I I I I I I I

Nice to see: I I

Similar to old fashion devices

Modern style: I I

Fix

Movable: I I I I I

Big: I I

Small: I I

Notes: Not too small because then it is difficult to read the text. It should not be too small. His wife thinks it is better if it has big buttons because he is used so now. The screen should not be too big neither to small, good enough to see a person and recognize the numbers without eyeglasses. He thinks that it should have the size of a normal fix telephone. As small as possible without compromise its utility. It will be easier to find if it stays at the same place.

Question 7: **Would you like to have a handle for privacy reasons or it's better to have a hand free set?**

Half of the participants would like to have a hand free set. 3 still prefer to have a handle to answer it and one would like to have both possibilities to answer.

Notes: Could be good to have a handle so that everybody else know what you are talking about.

Question 8: **How should the ring tone be?**

5 participants would like to have an old styled ring ring ringtone, the other three a fancy ringtone

Notes: I don't care about the melody, the important is that I can hear it well. It is important that we can regulate the volume of it. Important that I can control the sound, melody and volume. You have to hear it from far away. It is good if it has a signal that is different from other devices at home, for example the cooking timer. Possible to personalize it so that you know what it is ringing. I want to have a sound that I shall not misinterpret with other sounds. It is important that I can recognise the ringtone and not associate it with another device in my house.

Question 9: **How many people do you expect to have on the contact list?**

Don't know exactly: my daughters and some friends. 5 people (childhood's friends). 2 sons and 1 cousin. There should be a contact list with 5-6 places. A dozen. 15-20 (the first answer was 30 people, but then when he has been asked which ones do you call more often he went down to 15-20). My 4 sons. My sons (2) and my grandchildren it will be funny to see that I have something new (the videophone).

Question 10: **In which room of your apartment would you like to have it?**

Sleeping room: I

Living room: I I I I

Kitchen: I I I

Other: I (in the hallway that is in the middle of the apartment.

Question 11: **Would you like to move the camera and handle around the house to show something to the people you speak with?**

5 answered yes, 3 answered no.

Question 12: **Which aspect should it have according to your expectations?**

a) 5 participants liked this style

b) 2 this one

c)

1 would like to have this old fashioned one.

Notes:

b) Small and thin

b)Good that it is thin, does not take so much space. It is important that you can choose to turn off the camera if you do not want to be seen

a) looks simpler than b), maybe is easier to use because it has more buttons with number on it. Respondent chooses a if she must choose. She says it was bad pictures.

a) It is the best looking, but it would be better if you could hang up with an handle, It's better to not have a long cable so you won't stumble on it, good if it is flat so that it will not take too much space, would be nice to be able to adjust the light level of the image.

a) It should not be too big, 12x20 cm more or less, the same size of a mobile phone.

(A2) SWEDISH VERSION OF THE SURVEY

Undersökning om bildtelefon

Vi försöker att föreställa oss en bildtelefon som är speciellt designad just för dig. Med en sådan apparat kommer du att kunna prata gratis med din släkt, dina vänner och sjukvårdspersonal, samtidigt som du kan se dem på en skärm. Den du pratar med kommer även att kunna se dig.

För att kunna göra en bra sådan apparat behöver vi lite grundläggande information från dig.

1. **Vet du vad en bildtelefon är?**

   ☐ JA ☐ NEJ ☐ Ungefär

2. **Hur mycket pratar du i vanlig telefon nu?**

   a) mindre än 20 min/dag b) mindre än 20 min/vecka

   c) ungefär 1 timme/dag d) ungefär 1 timme/vecka

   e) mer än 2 timmar/dag f) mer än 2 timmar/vecka

3. **Ringer du själv eller tar du oftast emot samtal i din vanliga telefon?**

   ☐ Jag ringer oftast ☐ Jag tar oftast emot samtal ☐ både och

4. **Skulle du vilja kunna se dessa när du pratar med dem eller räcker det med att höra deras röst.**

Släktingar:	☐ Både bild och röst	☐ röst räcker	☐ Beror på
Vänner (ETC->)	☐ JA	☐ NEJ	☐ Beror på
Sjukvård	☐ JA	☐ NEJ	☐ Beror på

5. **Skulle du vilja att de kan se dig?**

   ☐ JA ☐ NEJ ☐ Beror på

6. **Vilken av dessa saker är viktigast för dig när du ska installerar något nytt i ditt hem ?**

   ☐ Den ska vara enkel att använda ☐ Den ska vara flyttbar

☐ Den ska vara snygg ☐ Den ska vara liten

☐ Den ska likna gamla apparater ☐ Den ska vara stor

☐ Den ska ha ett modernt utseende

7. Skulle du vilja ha en lur på telefonen eller en högtalartelefon?

☐ Lur ☐ Högtalartelefon ☐ båda

8. Hur bör ringsignalen vara? (ljud exempel)

☐ Ring ring ☐ bip bip ☐ avancerat ljud

9. Hur många personer tror du att du kommer att vilja ringa till med din bildtelefon om du hade en?

……

10. I vilket rum i huset skulle du vilja ha apparaten?

☐ Sovrummet ☐ Vardagsrummet

☐ Köket ☐ Annat ……..

11. Skulle du vilja att apparaten kunde flyttas runt i huset så att du skulle kunna visa något för den du pratar med?

☐ JA ☐ NEJ (fastsatt kamera och lur)

12. Vilken av dessa passar in på dina förväntningar ?

a)

b)

.....c)

Tack så mycket för hjälpen.

(A3) TEST PLAN:

It is really important when you want to start testing a prototype to begin by writing down the test plan. It will be a sort of milestone that you will have to follow at every cycle and point of the development of the project.

Once you start to test the prototype then it is absolutely necessary to freeze its development, no changes or updates are allowed until the end of the test phase. That could invalidate the chosen test design. But usually the test should be performed in one day.

OVERALL OBJECTIVES OF THIS STUDY:

Evaluate the newly created prototype of a new video phone for people with mild dementia and Alzheimer disease. Find out if it has a good usability and correct by iteration the bugs or problems that appear from testing.

We reached the stage of the development of the product that has already been iteratively improved with the suggestions of our teachers and the feedback from some experts in the field. Now it is time that the users that will have this device in their home are free to say their opinion on the tool and its functionality.

I hope that with the help of the participants we will be able to find out if there are some steps too complex or some other details that we have not considered in the design of the device. I think that only by observing the people while using and interacting with the video phone we can have a clearer idea about where we still need to adjust or improve the prototype. Or in the best hypothesis the product will be easily understood and our users will be able to use the product equally well.

After this test session there will be another improvement for the next iteration in order to correct the last details emerged from the usability testing. And once accomplished that I hope that a working beta version will be produced and retested before the final commercialization of the video phone for people with mild dementia and their life quality will consequently be improved.

RESEARCH QUESTIONS:

RQ1: Is the video phone prototype usable according to the ISO definition 9241-11? Will the participants be able to achieve the required task in an effective (successful) way, in a efficient amount of time and with satisfaction in using the tool?

RQ2: How easily and successfully can users use the emergency button on the device?

RQ3: What are the obstacles that prevent users from perform the required tasks?

RQ4: Which aspects created problem to the user and can furthermore be improved to increase users' satisfaction and their quality of life?

PARTICIPANT CHARACTERISTICS

The target user for this product will be an elderly person with MCI (Mild Cognitive Impairment) and early stage of AD (Alzheimer Disease), they are supposed to live alone or in couples at their own apartment. The users should be between 65 to 90 years old, their sex should be diversified so as their educational background.

Unfortunately we cannot access this kind of participants because of ethical problem. So we have to test the prototype with some elderly that are volunteering in testing it for us.

I was hoping to get at least 8 participants.

The participants will be provided from Karolinska Institutet Hospital and KTH. They have a range of patients that will voluntarily take part to the experiment. They will be conducted to the KTH buildings and tested individually with a moderator that will introduce them the tasks and observe them.

TASK LIST

Users will perform the following tasks in a sequence described in “Methodology” section of this document. For each task, the test moderator will instruct the participants about what s/he is supposed to do in order to achieve it successfully. Instructions will be given in Swedish, they can be repeated several times if needed.

Task A: Pick up an incoming call

We will simulate an incoming call and the participants will be asked to answer it by picking up the handset. Their task success will be to correctly pick up the phone and answer the call. We will also test if they notice the small cover for the webcam. The moderator will ask them what would they do if they don't want to be seen from the person that is calling them.

Task B: Call for emergency

In this task the participant is asked to call for help the emergency line by using the specific "Emergency Button". Once pressed the button there will be a confirmation screen. The user should then push again the emergency button or press a "SOS" icon on the screen in order to confirm the call.

Task C: Make a call to a friend from the contact list

The participant need to take the handset in order to activate the contact list page. This time the user has to find the correct name (Kate Green) in the list of proposed contacts and start the call to this designed person. Once selected the contact the participant need to confirm his choice by pressing again on the contact icon.

Task D: Icon recognition

If the user still has in his hand the handset it we can continue the test, otherwise we ask him/her to pick it up again. We will show them the action to hang up the handset, and check if they perform the action of putting it at the right position.

LOCATION AND SET UP

We have been offered to use the laboratory in KTH - Royal institute of Technology in Handen. In this High School they have two apartment-like laboratories where they are planning to test elderly people with new technological home furniture for people with disabilities. There are two distinct pieces and there it could be possible to simulate the video calls from a room to another.

The final idea is to use a touch screen computer with a video phone camouflage in order to test the hardware and the software at the same time.

Finally we conducted the test in a retirement house in Bålsta. We visited the participants in their apartment We used a normal 15" screen transformed in a video phone, and controlled their action through a laptop in order to simulate the touch screen function.

METHODOLOGY

In this usability study, we will:

1. Provide estimation of effectiveness, efficiency and satisfaction of using the video phone prototype. Both the hardware and software part will be studied.

2. Perform an exploratory study to find possible reasons to any probable obstacles to performing evaluated tasks.

Every participant has to go through a pre test questionnaire, the four tasks and a post test questionnaire. We don't see the necessity to mix up the order of the different tasks. There should not be problem of learn ability.

TEST MODERATOR ROLE

The test moderator (TM) is responsible to welcome the participants and made them feel at ease. S/he will short introduce them the video phone prototype and explain them the reason because they are there, to help us test a new device that soon could be in your houses to help you having a better quality of life.

S/he will take care about the ethical aspect and make them sign an agreement paper about the use of the results and the chance that they will be video recorded during the test session.

S/he will then introduce the different task to accomplish with the video phone and be available for any question the participants have. It is allowed to read several times the tasks. If some particular help is given then it has to be noted on the results paper.

S/he will be reading them the pretest and post test questionnaire collecting the participants' answers.

S/he will finally write down their opinion about the satisfaction in using the device and any remarks that come up from the participants. S/he will thanks them for their help, maybe give them a small present (a flower and a chocolate bar) as a reward for their time.

After the test the data should be reorganized and eventually it can be discussed with other people present (observers) to the test session so that some important details will not be lost.

DATA TO BE COLLECTED AND EVALUATION MEASURES

The success ratio. A observer and the TM should write down if the task is achieved or failed. The participants can always say STOP if they don't know how to proceed. The TM will ask to try a bit harder. The second time the participants say STOP the task is over and the TM can go to the next task or the test is over.

Count the number of times that a participant ask for help.

Mark down the typical errors made by the users.

REPORT CONTENTS AND PRESENTATION

We will deliver the final report to our point of contact at KTH and KI that:

• Briefly summarizes the background of the study, including the goals, methodology, logistics, and participant characteristics.

• Presents findings for the original questions to investigate.

• Gives quantitative results and discusses specifics as appropriate to the question and the data.

• If applicable, discusses the implications of the results.

• Suggests follow-on research

TEST DOCUMENTS:

In this part we will show how the test paper card will be done and explain what the role of the test moderator will be. We will translate it in Swedish for them so that it will be ready to test.

Starting point: the monitor will have a black screen and a phone handle will be hang up at the correct place.

We will control the test through a wireless mouse and click the button on PowerPoint for them. Eventually they can click through touch screen (if it is provided and working).

Moderator's Cards with task description:

TASK A:
Please Receive call

Moderator: "Now expect to receive a call"
Observe

- What will the participants do after they see the incoming call page?

Moderator: "What can you do if you don't want to be seen by the person that is calling you?".

TASK B
Please make an Emergency call (S/he will simulate an emergency)

Moderator: "Now you need to call for assistance. What would you do?

Observe:

- What are they going to do first?
- In the confirmation page, which button are they going to press, button on the screen or the physical button?

TASK C
Please make a call to granddaughter Kate Green.

Moderator: "Now you are going to call your granddaughter Kate Green"

Observe:

- What are they going to do first?
- What will they do to end the call?
- Observe whether they can use touch screen smoothly

TASK D:
Show the prompt of hanging up handset to them

Moderator: " What would you do if this animation appear?"
Observe:

- Do they understand the meaning of this page?

Pre-test questionnaire

1. How old are you? _____

2. Are you a female or male?

   Female male

3. Have you ever worked in any computer-related industries?

   Yes No

4. How long have you been a computer user?

   <1 year 1-3years 3-5 years >5years

5. Have you ever used any touch screen device?

   Yes No
   If yes, is it difficult for you to use touch screen device?
   Very difficult difficult easy very easy

6. Do you prefer Touch screen or physical button control?

   Touch screen physical button both are OK

7. Have you ever used any videophone device or software?

   Yes No
   If yes, how often do you use videophone device or software?
   Daily weekly monthly yearly

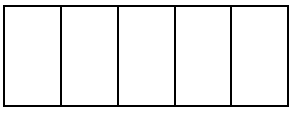
8. How many videophone contacts do you think you have?

   1-6 7-9 10 or more

Post test questionnaire

Question list 1:

1. I think that I would like to use this system frequently

Strongly disagree  Strongly agree

1 2 3 4 5

2. I found the system unnecessarily complex.

Strongly disagree Strongly agree

1 2 3 4 5

3. I think that I would need the support of a technical person to be able to use this system

Strongly disagree Strongly agree

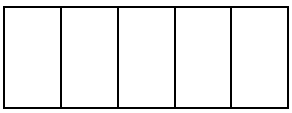
1 2 3 4 5

4. I would imagine that most people would learn to use this system very quickly

Strongly disagree Strongly agree

1 2 3 4 5

5. I felt very confident using the system

Strongly disagree  Strongly agree

1 2 3 4 5

6. I needed to learn a lot of things before I could get going with this system

Strongly disagree | | | | | | Strongly agree

1 2 3 4 5

Question list 2

1. I thought it was easy to receive a call with this system.

Strongly disagree | | | | | | Strongly agree

1 2 3 4 5

2. I thought it was easy to make an emergency call to care center with this system.

Strongly disagree | | | | | | Strongly agree

1 2 3 4 5

3. I thought it was easy to make a call to contact with this system.

Strongly disagree | | | | | | Strongly agree

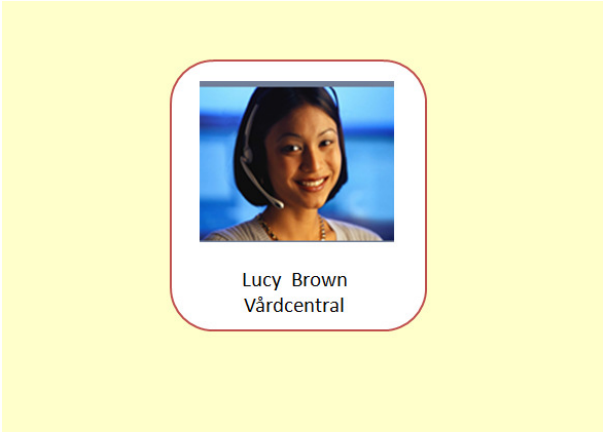
1 2 3 4 5

4. I think I like to use touch screen to make call to one contact.

Strongly disagree | | | | | | Strongly agree

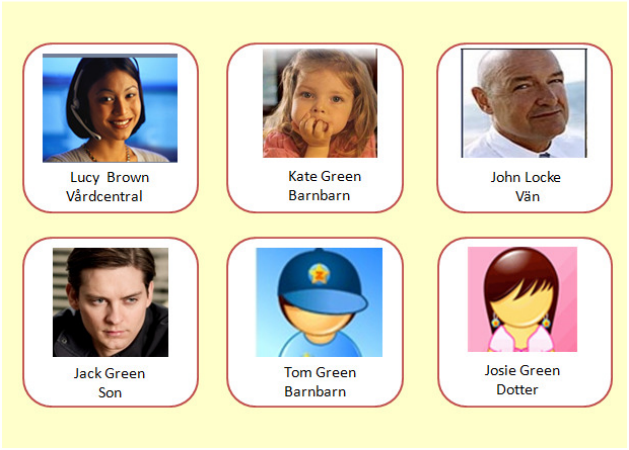
1 2 3 4 5

5. I think incoming call page shows me caller information clearly.



Strongly disagree						Strongly agree
	1	2	3	4	5	

6. I think contacts page shows me contacts information clearly.



Strongly disagree						Strongly agree
	1	2	3	4	5	

Other comments:

.....
.....
.....

(A4) THE MINI-MENTAL STATE EXAMINATION (MMSE):

Maximum score	Score	
		Orientation
5	__	What is the (year) (season) (date) (day) (month)?
5	__	Where are we: (state) (county) (town or city) (hospital) (floor)?
		Registration
3		Name three common objects (e.g., "apple," "table," "penny"): Take one second to say each. Then ask the patient to repeat all three after you have said them. Give one point for each correct answer. Then repeat them until he or she learns all three. Count trials and record.
	__	Trials: ___
		Attention and clalculation
5		Spell "world" backwards. The score is the number of letters in correct order.
	__	(D___L___R___O___W___)
		Recall
3		Ask for the three objects repeated above. Give one point for each correct answer. (Note: recall cannot be tested if all three objects were not remembered during
	__	registration.)
		Language
2		Name a "pencil" and "watch."
	__	Repeat the following: "No ifs, ands or buts."
1	__	Follow a three-stage command:
3	__	"Take a paper in your right hand, fold it in half and put it on the floor."
1	__	Close your eyes.
1	__	Write a sentence.
1		Copy the following design.

	__	
Total score:	__	

(A5) THE TEST DOCUMENTATION IN SWEDISH:

PRE-TEST QUESTIONNAIRE:

Inför testet (Ringa in ditt svar)

1. Hur gammal är du? _____

2. Är du man eller kvinna?
   Man Kvinna

3. Har du använt dator i ditt arbete?
   Ja, vilken?_____ Nej

4. Hur länge har du varit datoranvändare?
   Mindre än 1 år 1-3 år 3-5 år Över 5 år

5. Har du någon gång använt pekskärm?
   Ja Nej

   Om ja, var det svårt för dig att använda en pekskärm?
   Mycket svårt svårt lagom lätt mycket lätt

6. Föredrar du pekskärm eller knappar för att använda en bildtelefon?
   Pekskärm Knappar båda är bra

7. Har du någon gång använt en bildtelefon?

   Ja Nej

   Om ja, hur ofta använder du bildtelefonen?
   Dagligen veckovis måndadsvis årsvis

8. Har du någon gång använt ett program för bildsamtal på dator?
   Ja Nej

Om ja, hur ofta använder du programmet?
Dagligen veckovis måndadsvis årsvis

9. Hur många kontakter skulle du uppskatta att du har i bildtelefon telefonboken?
   0 1-6 7-12 annars: _____

TASK LIST:

TASK 1

Ta emot samtal

Moderator: "Du kommer nu att få ett inkommande samtal"
Observera:

-Vad kommer de göra efter de sett den sidan?

Moderator: "Vad kan du göra om du inte vill synas".

TASK 2

Ring ett nödsamtal

Moderator: "Nu måste du ringa efter hjälp. Hur skulle du göra?
Observera:

- Vad är det första åtgärder som de utför?
-På bekräftningssidan, vilken knapp ska du trycka på, knappen på skärmen eller den fysiska knappen?

TASK 3

Ring till ditt barnbarn Kate Green.

Moderator: "Nu ska du ringa ditt barnbarn Kate Green"
Observera:
-Vad ska de göra först?
-Vad skall de göra för att avsluta samtalet?
-Observera om de kan använda pekskärmen smidigt

TASK 4

Visa "Kom ihåg att lägga på luren" sidan för dem

Moderator: "Vad skulle du göra om denna sida visas?"
Observera:

-Förstår de innebörden av denna sida?

POST TEST QUESTIONNAIRE:

Frågelista 1

1. Jag tror att jag skulle vilja använda en bildtelefon.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

2. Jag tyckte att denna bildtelefon var onödigt komplicerad.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

3. Jag tror att jag kommer att behöva hjälp av någon för att kunna använda denna bildtelefon.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

4. Jag kan tänka mig att de flesta skulle lära sig att använda denna bildtelefon mycket snabbt.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

Frågelista 2

1. Jag tyckte det var lätt att ta emot ett samtal med bildtelefonen.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

2. Jag tyckte det var lätt att ringa ett nödsamtal med bildtelefonen.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

3. Jag tyckte det var lätt att ringa till en person med bildtelefonen.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

4. Jag tycker det gick bra att använda pekskärmen för att ringa upp.

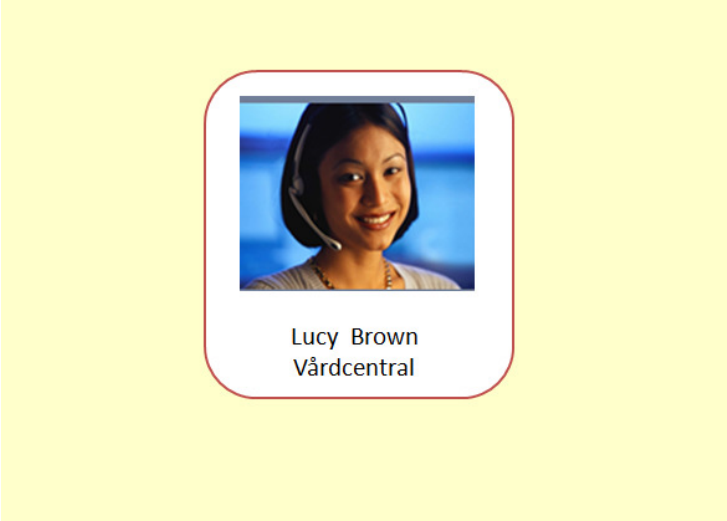
| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

5. Jag tycker att sidan för inkommande samtal visar tydlig information om vem som ringer.

| 1 | 2 | 3 | 4 | 5 |

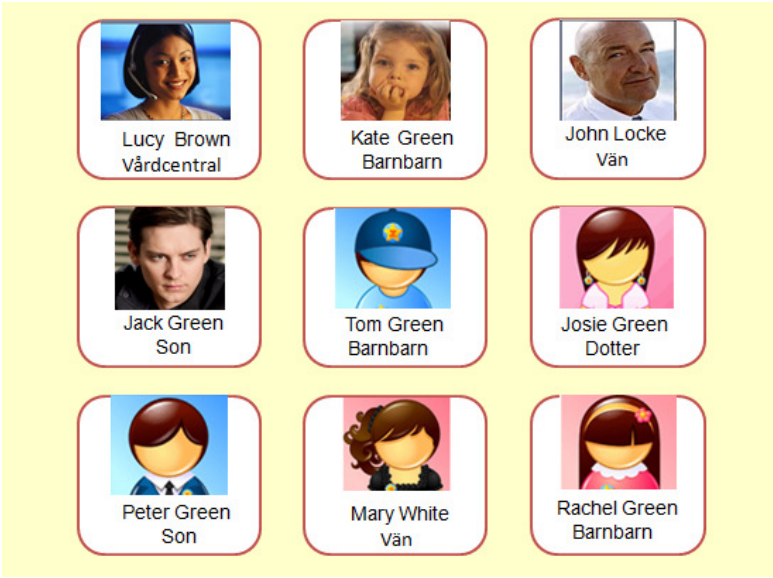
Instämmer inte alls Instämmer helt



6. Jag tycker att sidan med mina kontakter är tydlig.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt



7. Jag tycker det är latt att hitta den jag vill ringa till.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

8.Jag tycker att information om personen jag talar med ska synas under samtalet.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

8. Jag gillar utseendet på bildtelefonen.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

9. Jag tycker knappen för nödsamtal är bra.

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

10. Jag tycker att telefonluren är bra placerad..

| 1 | 2 | 3 | 4 | 5 |

Instämmer inte alls Instämmer helt

Andra kommentar: .....

.....
.....
.....
.....
.....

(A6) RESULTS OF THE TEST SESSION

Participant 1:

TASK	Success	Time needed	Remarks
Task 1	Yes	12 sec	He was able to cover the webcam:
Task 2	Yes	27 sec	Used first the red button, then pushed SOS button on the screen to confirm the call.
Task 3	Yes	26 sec	
Task 4	Yes	10 sec	

Participant 2:

TASK	Success	Time needed	Remarks
Task 1	Yes	10 sec	She was not able to cover the webcam. She pushed the arrow cover as a button instead of sliding it
Task 2	Yes	45 sec	She pushed 2 times the red button, needed some help (she would have pressed the personal alarm button on her bracelet)
Task 3	Yes	53 sec	It took her a while to go through the list of names
Task 4	Yes	12 sec	The position of the hook was to high

Participant 3:

TASK	Success	Time needed	Remarks
Task 1	Yes	missing	She didn't want to close the webcam, she want the people to see her.
Task 2	No	-	She would use her personal alarm on the bracelet
Task 3	No	-	The technology was too advanced, she did not understand it
Task 4	Yes		The responder hook was too high and difficult to access for her

Pre-test questionnaire result:

P1:

1. Age: 64
2. Sex: Man
3. Never worked with computer
4. Use it sometimes in the free time
5. Never used a touch screen before
6. Prefer touch screen to the buttons

7. Never used a video phone before
8. Tried a video phone software on the computer
9. He expect 0 contacts on his phonebook

P2:

1. Age: 93
2. Sex: Woman
3. Never worked with computer
4. Never used
5. Never used a touch screen before
6. Prefer buttons
7. Never used a video phone before
8. Never tried a video phone software on the computer
9. She expect 0 contacts on his phonebook

P3:

1. Age: 97
2. Sex: Woman
3. Never worked with computer
4. Never used
5. Never used a touch screen before
6. She doesn't know
7. Never used a video phone before
8. Never tried a video phone software on the computer
9. He expect 0 contacts on his phonebook

Post Test questionnaire results:

P1

Question list 1:

1. 1
2. 1
3. 1
4. 5

Question list 2:

1. 5
2. 5
3. 5
4. 5
5. 5
6. 3
7. -
8. -
9. -
10. -
11. 1

    Comments: Telephone handset too high to reach. We should combine the phone with the television, bigger screen and use the remote controller.

P2

Question list 1:

1. 5
2. 1
3. 1
4. 3 (It was easy to learn)

Question list 2:

1. 5
2. 5
3. 5
4. 5
5. 5
6. 5
7. 1
8. 5
9. 2 (the gray borders are boring)
10. 5
11. 4 (placed in a good place, but too high to reach)
    Comments: Emergency button hard to reach up there.

P3

Question list 1:

1. 1
2. 5
3. 4
4. 1

[i] R. Orpwood, A. Sixsmith, J. Torrington, J. Chadd, G. Gibson and G. Chalfont, Designing technology to support quality of life of people with dementia, Technology and Disability IOS Press, 2007

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[iii] C. Malinowsky, L. Nygård and A. Kottorp, Psychometric evaluation of a new assessment of the ability to manage technology in everyday life, Karolinska Institutet, Sweden, 2009

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[v] L. Nygård, S. Starkhammar, The use of everyday technology by people with dementia living alone: mapping out the difficulties. Aging and mental health, 2007 UK

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